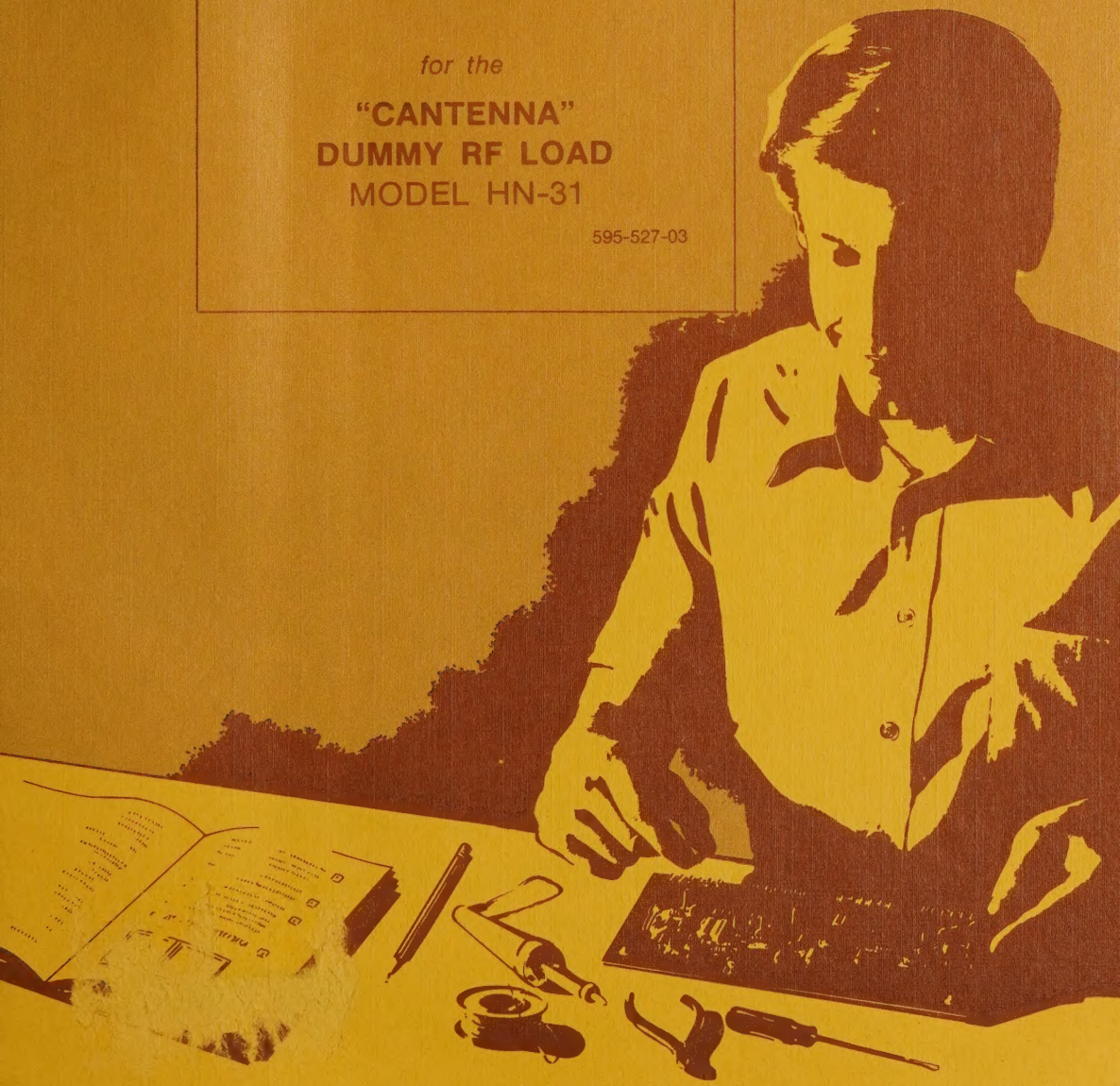
# HEATHKIT® MANUAL

*for the*

**"CANTENNA"**
**DUMMY RF LOAD**
MODEL HN-31

595-527-03



HEATH COMPANY • BENTON HARBOR, MICHIGAN

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HEATH COMPANY
BENTON HARBOR, MI. 49022

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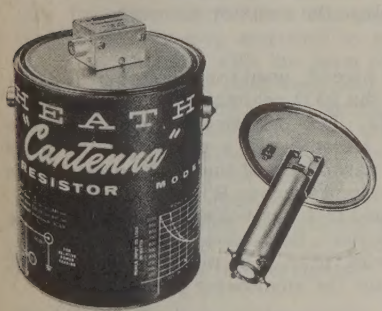
Assembly
and
Operation
of the

HEATHKIT

# "CANTENNA" DUMMY RF LOAD

MODEL HN-31

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## SPECIFICATIONS

| | |
|---|---|
| Impedance | 50 Ω. |
| Voltage Standing Wave Ratio (VSWR) | Less than 1.5 up to 300 mc. |
| | Less than 2.0 up to 400 mc. |
| Power Dissipation Capability | 1 kilowatt maximum (ICAS). |
| Size | 8-7/8" high x 7" diameter, overall. |
| Net Weight | 1-1/2 lbs (oil not included). |

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## CIRCUIT DESCRIPTION

The Model HN-31 "Cantenna" Dummy RF Load was designed as a small convenient package capable of handling a kilowatt of power. (See Figure 1). The oil-cooled, temperature- stable resistive element provides a very low VSWR (voltage standing wave ratio) up to 400 megacycles. A special circuit is incorporated to provide a DC voltage for monitoring relative output power.

Refer to the Schematic Diagram on Page 3 for a better understanding of the following description.

When power is applied to the circuit, R1, the 50 Ω resistor element (dummy load), absorbs this power and converts it into heat. The heat is dissipated into and stabilized by the oil bath which envelops the resistor element.

The output circuit, used for monitoring, is isolated from the 50 Ω resistor element (input circuit) by R2. This relatively high impedance separation allows only a portion of the input voltage to pass to R3 of the output circuit. The voltage developed across R3 is presented to D1. (Keep in mind that this voltage is relative to the input RF power). Half-wave diode rectifier D1, combined with filter capacitor C1, presents a DC output voltage for monitoring purposes.

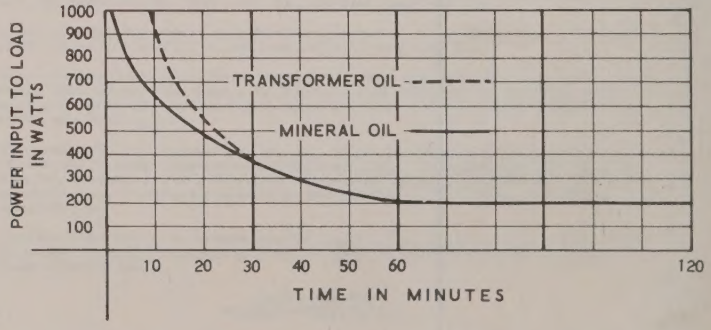
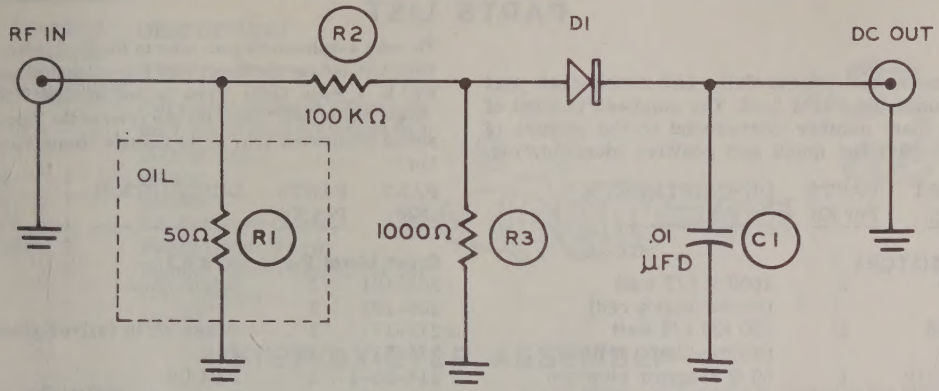



Figure 1




**SCHEMATIC OF THE HEATHKIT® "CANTENNA" DUMMY R F LOAD MODEL HN-31**

## CONSTRUCTION NOTES

The following instructions are presented in a logical step-by-step sequence to enable you to complete your kit with the least possible confusion. Be sure to read each step all the way through before beginning the specified operation. Also read several steps ahead of the actual step being performed. This will familiarize you with the relationship of the subsequent operations. When the step is completed, check it off in the space provided. This is particularly important as it may prevent errors or omissions, especially if your work is interrupted.

In general, the illustrations in this manual correspond to the actual configuration of the kit; however, in some instances the illustrations may be slightly distorted to facilitate clearly showing all of the parts.

The abbreviation "NS" indicates that a connection should not be soldered yet as other wires will be added. When the last wire is installed, the terminal should be soldered and the abbreviation "S" is used to indicate this. Note that a number will appear after each solder instruction. This number indicates the number of leads that are supposed to be connected to the terminal in point before it is soldered. For example, if the instruction reads, "Connect a lead to lug 1 (S-2)," it will be understood that there will be two leads connected to the terminal at the time it is soldered. (In cases where a lead passes through a terminal or lug and then connects to another point, it will count as two leads, one entering and one leaving the terminal.)

Position the work, if possible, so that gravity will help to keep the solder where you want it. The joint to be soldered should be heated with the flat side of the soldering iron tip sufficiently to melt the solder. Apply only enough solder to the heated terminal to thoroughly wet the junction. Remove the solder and then the iron when a smooth solder junction appears. Do not move the leads until the solder is solidified.

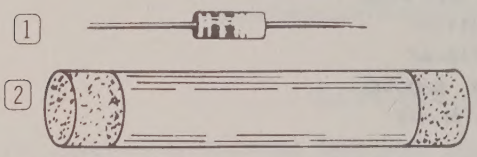
ROSIN CORE SOLDER HAS BEEN SUPPLIED WITH THIS KIT. THIS TYPE OF SOLDER MUST BE USED FOR ALL SOLDERING IN THIS KIT. ALL GUARANTEES ARE VOIDED AND WE WILL NOT REPAIR OR SERVICE EQUIPMENT IN WHICH ACID CORE SOLDER OR PASTE FLUXES HAVE BEEN USED. IF ADDITIONAL SOLDER IS NEEDED, BE SURE TO PURCHASE ROSIN CORE (60:40 or 50:50 TIN-LEAD CONTENT) RADIO TYPE SOLDER.

# PARTS LIST

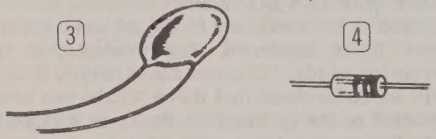
Unpack the kit carefully and check each part against the Parts List. The numbers in front of the part number correspond to the picture of that part for quick and positive identification.

To order a replacement part, refer to the Replacement Parts Price List and use the Parts Order Form furnished with this kit. If a Parts Order Form is not available, refer to "Replacement Parts" inside the rear cover of the Manual. For pricing information, refer to the separate "Heath Parts Price List."

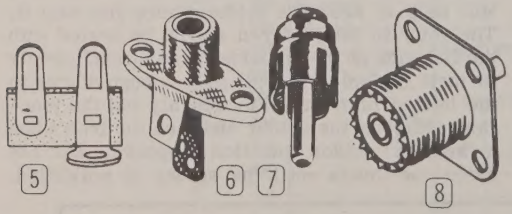
| PART No. | PARTS Per Kit | DESCRIPTION |
|---|---|---|
| **RESISTORS** | | |
| [1] 1-9 | 1 | 1000 Ω 1/2 watt (brown-black-red) |
| 1-26 | 1 | 100 KΩ 1/2 watt (brown-black-yellow) |
| [2] 1-2-10 | 1 | 50 Ω resistor element (dummy load) |



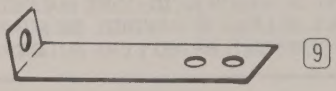
| | | |
|---|---|---|
| **CAPACITOR-DIODE** | | |
| [3] 21-16 | 1 | .01 μfd disc ceramic capacitor |
| [4] 56-26 | 1 | Crystal diode (brown-white-brown) |



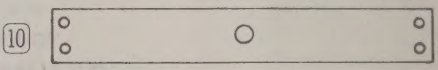
| | | |
|---|---|---|
| **TERMINAL STRIP-CONNECTOR** | | |
| [5] 431-14 | 1 | Terminal strip |
| [6] 434-42 | 1 | Phono socket |
| [7] 438-4 | 1 | Phono plug |
| [8] 436-5 | 1 | Coaxial connector |



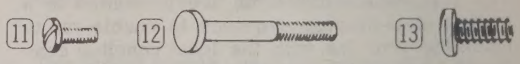
| | | |
|---|---|---|
| **SHEET METAL PARTS** | | |
| [9] 204-468 | 2 | Bracket |



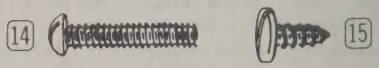
| | | |
|---|---|---|
| **Sheet Metal Parts (cont'd.)** | | |
| 206-191 | 1 | Shield base |
| 206-192 | 1 | Cover |
| [10] 212-17 | 3 | Brass strip (silver plated) |
| 214-57 | 1 | Pail |
| 214-58-1 | 1 | Pail lid |
| 206-193 | 1 | Shield tube (5" long) |



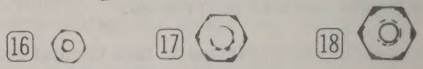
| | | |
|---|---|---|
| **HARDWARE** | | |
| [11] 250-49 | 12 | 3-48 x 1/4" screw |
| [12] 250-120 | 1 | #5 x 7/8" stud screw |
| [13] 250-89 | 5 | 6-32 x 3/8" screw |



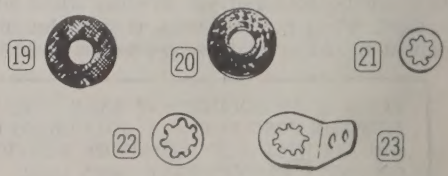
| | | |
|---|---|---|
| [14] 250-134 | 4 | 6-32 x 3/4" brass screw |
| [15] 250-170 | 6 | #6 x 1/4" sheet metal screw |



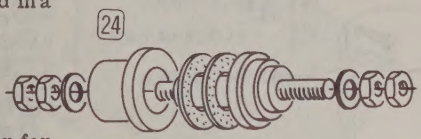
| | | |
|---|---|---|
| [16] 252-1 | 12 | 3-48 nut |
| [17] 252-3 | 17 | 6-32 nut |
| [18] 252-40 | 2 | 5-40 nut |

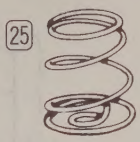


| | | |
|---|---|---|
| [19] 253-1 | 2 | Fiber washer |
| [20] 253-2 | 1 | Fiber shoulder washer |
| [21] 254-7 | 8 | #3 lockwasher |
| [22] 254-1 | 7 | #6 lockwasher |
| [23] 259-1 | 1 | Solder lug |



| PART No. | PARTS Per Kit | DESCRIPTION |
|---|---|---|
| **MISCELLANEOUS** | | |
| (23) 71-2 | 1 | Ceramic insulator (This part may come disassembled in a plastic bag.) |
| (25) 258-30 | 1 | Spring |
| 211-25 | 1 | Handle |
| 597-308 | 1 | Kit Builders Guide |
| 597-260 | 1 | Parts Order Form |
| | 1 | Manual (See front cover for part number.) |
| | | Solder |



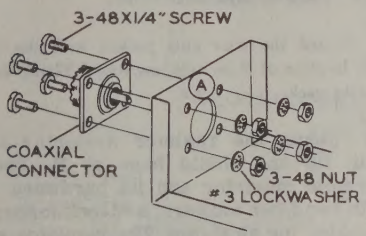




## STEP-BY-STEP ASSEMBLY

### PARTS MOUNTING

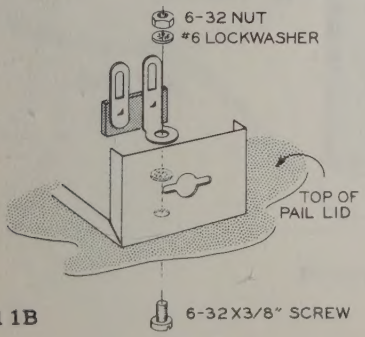
Refer to Pictorial 1 for the following steps.

( ) Mount the coaxial connector to the shield base at A as shown in Pictorial 1. Use 3-48 x 1/4" screws, #3 lockwashers, and 3-48 nuts as illustrated in Detail 1A.



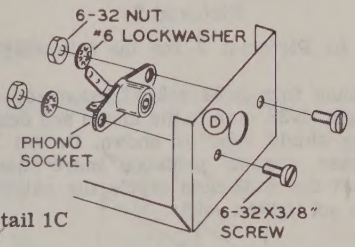

Detail 1A

( ) Mount the shield base to the top of the pail lid, using a 6-32 x 3/8" screw, #6 lockwashers, a terminal strip, and a 6-32 nut at C, as shown in Detail 1B. Position the shield base so that its three holes are in line with the three associated holes in the pail lid. Make sure the terminal strip is positioned as shown in Pictorial 1.




Detail 1B

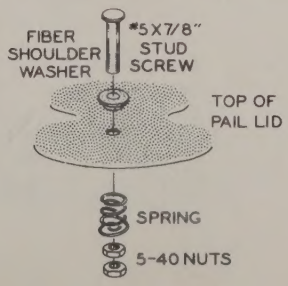
( ) Mount the phono socket at D, using 6-32 x 3/8" screws, #6 lockwashers, and 6-32 nuts as shown in Detail 1C. Bend the center conductor up 45 degrees.



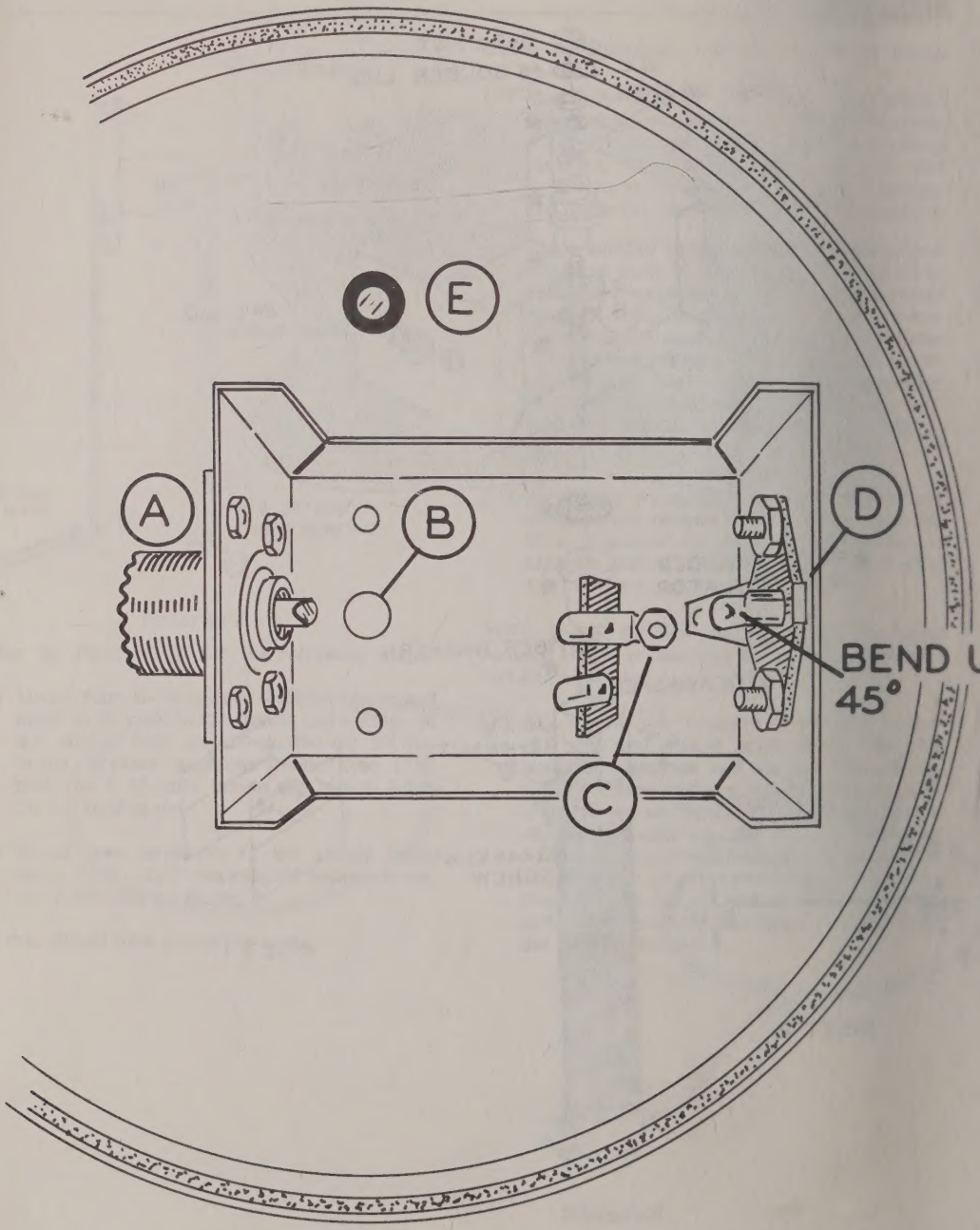

Detail 1C

( ) Assemble the relief valve at E, using a #5 x 7/8" stud screw, fiber shoulder washer, spring, and 5-40 nuts as shown in Detail 1D. The 5-40 nuts should be tightened to the stud screw shoulder.

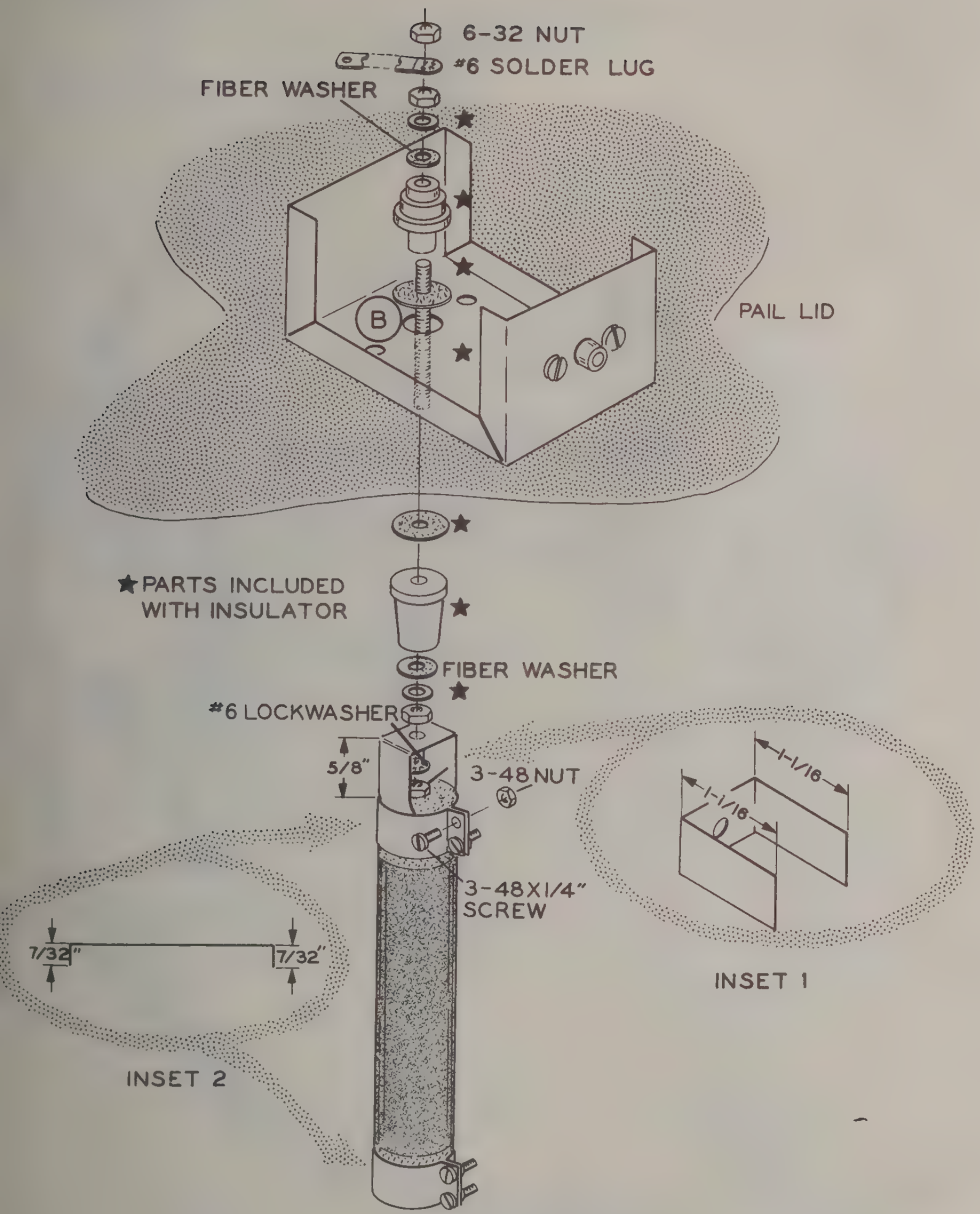
Set this pail lid assembly aside temporarily.



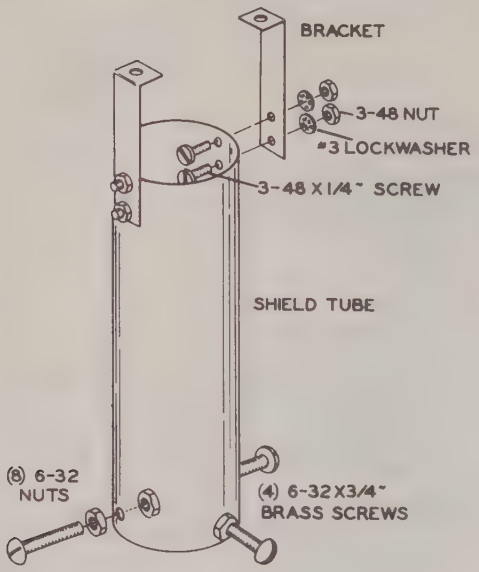

Detail 1D




Pictorial 1


6-32 NUT
#6 SOLDER LUG
FIBER WASHER
PAIL LID
B
★PARTS INCLUDED WITH INSULATOR
FIBER WASHER
#6 LOCKWASHER
5/8"
3-48 NUT
3-48 X 1/4" SCREW
7/32"
7/32"
INSET 2
1-1/16"
1-1/16"
INSET 1

Pictorial 3




Pictorial 2

Refer to Pictorial 2 for the following steps.

( ) Mount four 6-32 x 3/4" brass screws and eight 6-32 nuts to the inside and outside of the shield tube as shown. Do not let the brass screws protrude more than 1/8" past the 6-32 nuts inside the shield tube. Do not tighten yet.

( ) Mount two brackets to the shield tube, using 3-48 x 1/4" screws, #3 lockwashers, and 3-48 nuts as shown.

Set this shield tube assembly aside.

Refer to Pictorial 3 for the following steps.

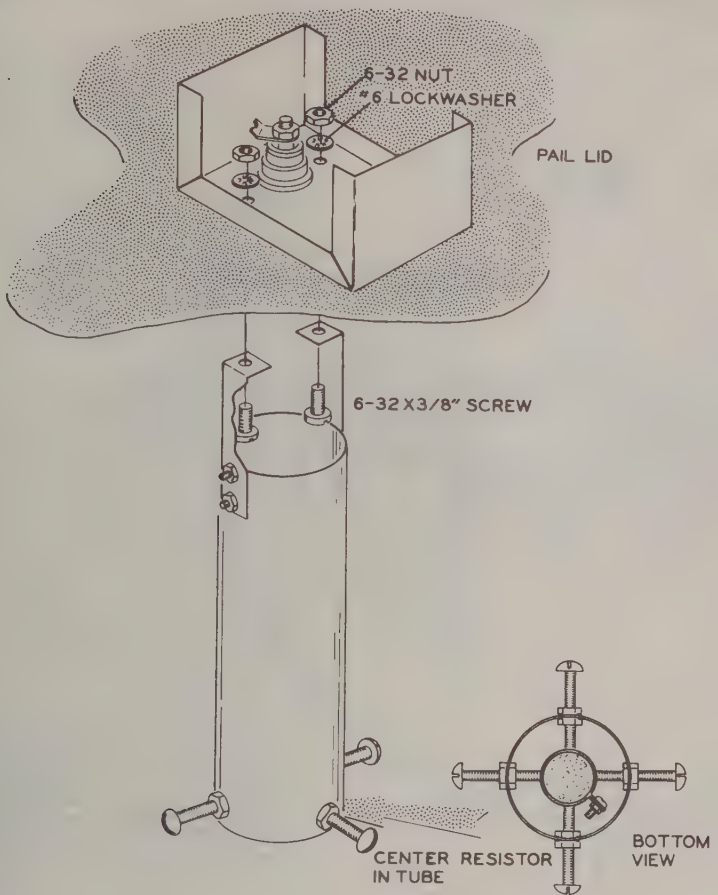
( ) Shape the ends of one of the silver plated brass strips as shown in inset #2. Wrap this strip around one end of the 50 Ω resistor element. Use 3-48 x 1/4" screws, and 3-48 nuts to tie the end of this strip together but leave the hardware as loose as possible.

( ) Shape another brass strip to the dimensions shown in inset #1. Push the ends of this strip between the resistor element and the loosely wrapped strip. It may be necessary to form the end of the second brass strip to conform to the round resistor element. Leave a 5/8" gap between the resistor element and this strip before tightening the hardware securely. Pictorial 3 shows the correct installation.

( ) Shape the remaining silver-plated brass strip to the dimensions shown in inset #2. Wrap it around the other end of the resistor element and securely tighten it with 3-48 x 1/4" screws and 3-48 nuts.

NOTE: Discard the four nuts packed with the ceramic insulator. In place of these nuts, use four 6-32 nuts from the kit hardware pack.

( ) R1. Mount the resistor assembly to the pail lid and shield base at B. Use the ceramic insulator and its hardware along with two fiber washers, a #6 lockwasher, and a solder lug as shown. The insulator screw should protrude equally at each end. The solder lug should be straightened out with the end of it cut off at the second hole as shown. Position the cut off end of the solder lug under and touching the inner conductor of the coaxial connector.

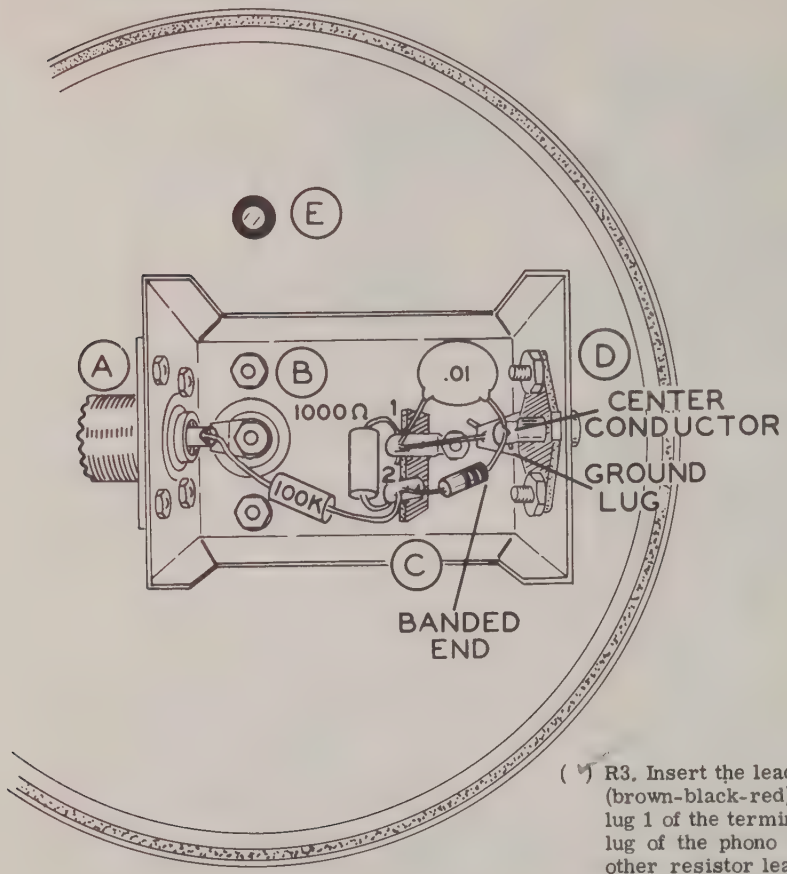



Pictorial 4

Refer to Pictorial 4 for the following steps.

(1) Mount the shield tube assembly to the pail lid and shield base, using 6-32 x 3/8" screws, #6 lockwashers, and 6-32 nuts as shown. It may be necessary to loosen and re-tighten the insulator assembly to allow the brass strip connection on the bottom of the resistor to center between two of the brass screws.

(2) Adjust the four brass screws so that the 50 Ω resistor is centered as shown in the bottom view, then tighten securely. The 6-32 nuts on the brass screws should be tight against the shield tube.




## COMPONENT WIRING

Pictorial 5

Refer to Pictorial 5 for the following steps. In the following steps, cut and position the leads of the components as shown. Set the lid on top of the pail temporarily to support it while performing the wiring steps.

( ) R2. Connect the 100 KΩ (brown-black-yellow) 1/2 watt resistor from lug 2 of the terminal strip (NS) to the hole in the inner conductor of the coaxial connector (S-1). Make sure the solder lug is also soldered to the connection at this time.

( ) R3. Insert the lead on one end of the 1000 Ω (brown-black-red) 1/2 watt resistor through lug 1 of the terminal strip (NS) to the ground lug of the phono socket (S-1). Connect the other resistor lead to lug 2 of the terminal strip (NS).

( ) C1. Connect the .01 μfd disc ceramic capacitor from lug 1 of the terminal strip (S-3) to the center conductor of the phono socket (NS).

CAUTION: Do not apply excessive heat to the leads of the crystal diode in the following step. Use a pair of long-nose pliers, with a rubber band wrapped around the handles, as a heat sink. The pliers can be clipped to the diode lead to dissipate the heat when soldering.

( ) D1. Connect the lead on the banded end of the crystal diode to the inner conductor of the phono socket (S-2). Connect the other lead to lug 2 of the terminal strip (S-3).

This completes the wiring. Make sure all components are connected to the proper places and securely soldered. Shake out any loose wire clippings and solder splashes.

## INITIAL OPERATION CHECK

If an ohmmeter is handy, the input circuit may be checked. Proceed to the Final Assembly if you do not have an ohmmeter to make this check.

( ) Clip the common lead of your ohmmeter to the shield base and touch the other lead to the inner conductor of the coaxial connector. A reading between 45 and 55 ohms should result, depending upon the accuracy of your ohmmeter. If your reading does not fall within a few ohms of this range, refer to the In Case Of Difficulty section of the manual. Continue with Final Assembly if your kit checks out as just described.

## FINAL ASSEMBLY

Refer to Pictorial 6 for the following steps.

( ) Install the handle on the pail.

( ) Mount the shield cover to the shield base, using six #6 x 1/4" sheet metal screws.

( ) Pour transformer oil into the pail until it reaches a level about 3/4" from the top. It is mandatory for proper oil circulation that the oil level be about 1/4" above the shield tube or resistor element when the pail lid is installed. The recommended transformer oil may be obtained from most any bulk oil plant. If transformer oil is not available, mineral oil may be used, but do not use any type of motor oil. The vaporizing temperature of motor oil is too low and would cause excess vapor.

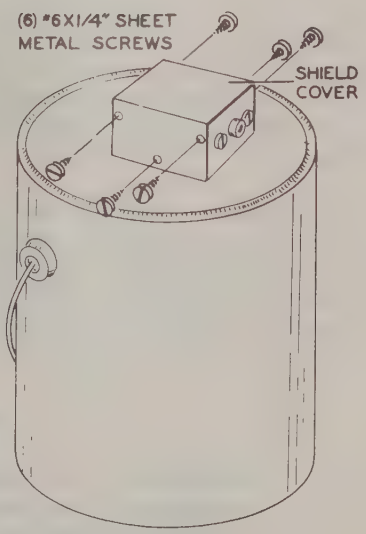
( ) Install the pail lid to the pail by tapping around the edge of the pail lid with a hammer handle until the lid is completely seated in the pail. Use care not to bend the lid or chip the paint.

NOTE: The blue and white identification label shows the Model Number and Production Series Number of your kit. Refer to these numbers in any communications with the Heath Company; this assures you that you will receive the most complete and up-to-date information in return.

( ) Install the identification label in the following manner:

1. Select a location for the label where it can easily be seen when needed, but will not show when the unit is in operation. This location might be on the bottom of the can or inside of the shield cover.

2. Carefully peel away the backing paper. Then press the label into position.




Pictorial 6

This completes assembly. It may now be placed into operation as instructed in the Operation section of this manual.

## OPERATION

Before connecting the Dummy Load to an RF power device, become thoroughly familiar with the duty cycle curves shown in Figure 1 of the Specifications. If you are uncertain of the power level being applied to the Dummy Load, safe operation can periodically be checked in the following manner. Touch the side of the pail near the bottom with your fingers; if you are unable to hold your fingers on the pail for more than a few seconds, the RF power device should be turned off until the oil cools. If at any time you notice vapor coming from the relief valve, turn off the RF power device. If vapor appears with a power input of 200 watts or less, the oil level should be checked. After becoming thoroughly familiar with the preceding information, connect the RF power device to the coaxial connector on the top of the Dummy Load. If you desire a relative power indicator for tuning of the RF power device a VTVM or VOM, set on its DC range, can be connected to the phono socket. The center terminal is positive. This reading is only a relative power indication.

## IN CASE OF DIFFICULTY

1. Recheck the wiring. Trace each lead in colored pencil on the Pictorial as it is checked. It is frequently helpful to have a friend check your work. Someone who is not familiar with the unit may notice something consistently overlooked by the constructor.

2. It is interesting to note that about 90% of the kits that are returned for repair do not function properly due to poor connections and soldering. Therefore, many troubles can be eliminated by reheating all connections to make sure that they are soldered.

3. Check for bits of solder, wire ends or other foreign matter which may be lodged in the wiring.

4. Check the Mechanical Assembly of the 50 Ω resistor element for proper installation.

NOTE: In an extreme case where you are unable to resolve a difficulty, refer to the Service and Warranty section of the "Kit Builders Guide", and to the "Factory Repair Service" information on Page 11 of this Manual.

## WARNING

**Transformer oil contains significant amounts of polychlorinated biphenyl (PCB). The chemical is used to improve the heat resistance properties of the oil.**

**If you use transformer oil in your Cantenna, be very careful when you handle the oil. Wash your hands after you fill the pail, and keep the oil away from food and children.**

**If the Cantenna overheats, turn off the RF power device immediately, and make sure you do not breathe any vapor from the overheated oil.**

**Contact your local oil company and/or power company for advice on disposing of used oil.**

**The above does not apply to mineral oil, since it does not contain PCB.**

## FOR PARTS REQUESTS ONLY

- Be sure to follow instructions carefully.
- Use a separate letter for all correspondence.
- Please allow 10 - 14 days for mail delivery time.

**DO NOT WRITE IN THIS SPACE**

### INSTRUCTIONS

- Please print all information requested.
- Be sure you list the correct **HEATH** part number exactly as it appears in the parts list.
- If you wish to prepay your order, mail this card and your payment in an envelope. Be sure to include 10% (25¢ minimum, $3.50 maximum) for insurance, shipping and handling. Michigan residents add 4% tax.
  Total enclosed $_____
- If you prefer COD shipment, check the COD box and mail this form. COD ☐

NAME _____

ADDRESS _____

CITY _____

STATE _____ ZIP _____

The information requested in the next two lines is not required when purchasing nonwarranty replacement parts, but it can help us provide you with better products in the future.

Model # _____ Invoice # _____

Date Purchased _____ Location Purchased _____

| LIST **HEATH** PART NUMBER | QTY. | PRICE EACH | TOTAL PRICE |
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|---|---|
| TOTAL FOR PARTS | |
| HANDLING AND SHIPPING | |
| MICHIGAN RESIDENTS ADD 4% TAX | |
| **TOTAL AMOUNT OF ORDER** | |

SEND TO: **HEATH COMPANY**
BENTON HARBOR
MICHIGAN 49022
**ATTN: PARTS REPLACEMENT**

Phone (Replacement parts only): 616 982-3571

THIS FORM IS FOR U.S. CUSTOMERS ONLY
OVERSEAS CUSTOMERS SEE YOUR DISTRIBUTOR

CUT ALONG DOTTED LINE


## FOR PARTS REQUESTS ONLY

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THIS FORM IS FOR U.S. CUSTOMERS ONLY
OVERSEAS CUSTOMERS SEE YOUR DISTRIBUTOR

# CUSTOMER SERVICE

## REPLACEMENT PARTS

If you need a replacement part, please fill in the Parts Order Form that is furnished and mail it to the Heath Company. Or, if you write a letter, include the:

- **Part number** and **description** as shown in the **Parts List.**
- Model number and Series number from the blue and white label.
- Date of purchase.
- Nature of the defect.

**Please do not return parts** to the factory unless they are requested. Parts that are damaged through carelessness or misuse by the kit builder will not be replaced without cost, and will not be considered in warranty.

Parts are also available at the Heathkit Electronic Centers listed in your catalog. Be sure to provide the Heath part number. Bring in the original part when you request a warranty replacement from a Heathkit Electronic Center.

NOTE: Replacement parts are maintained specifically to repair Heathkit products. Parts sales for other reasons will be declined.

## TECHNICAL CONSULTATION

Need help with your kit? . . . . Self-Service? . . . . Construction? . . . . Operation? . . . . Call or write for assistance. You'll find our Technical Consultants eager to help with just about any technical problem except "customizing" for unique applications.

The effectiveness of our consultation service depends on the information you furnish. Be sure to tell us:

- The Model number and Series number from the blue and white label.
- The date of purchase.
- An exact description of the difficulty.
- Everything you have done in attempting to correct the problem.

Also include switch positions, connections to other units, operating procedures, voltage readings, and any other information you think might be helpful.

**Please do not send parts for testing,** unless this is specifically requested by our Consultants.

Hints: Telephone traffic is lightest at midweek. . .please be sure your Manual and notes are on hand when you call.

Heathkit Electronic Center facilities are also available for telephone or "walk-in" personal assistance.

## REPAIR SERVICE

Service facilities are available, if they are needed, to repair your completed kit. (Kits that have been modified, soldered with paste flux or acid core solder, cannot be accepted for repair.)

**If it is convenient, personally deliver your kit to a Heathkit Electronic Center. For warranty parts replacement, supply a copy of the invoice or sales slip.**

If you prefer to ship your kit to the factory, attach a letter containing the following information directly to the unit:

- Your name and address.
- Date of purchase.
- Copies of all correspondence relevant to the service of the kit.
- A brief description of the difficulty.
- Authorization to return your kit C.O.D. for the service and shipping charges. (This will reduce the possibility of delay.)

Check the equipment to see that all screws and parts are secured. (Do not include any wooden cabinets or color television picture tubes, as these are easily damaged in shipment.) Place the equipment in a strong carton with at least THREE INCHES of *resilient* packing material (shredded paper, excelsior, etc.) on all sides. Use additional packing material where there are protrusions (control sticks, large knobs, etc.). If the unit weighs over 15 lbs., place this carton in another one with 3/4" of packing material between the two.

Seal the carton with reinforced gummed tape, tie it with a strong cord, and mark it "Fragile" on at least two sides. Remember, the carrier will not accept liability for shipping damage if the unit is insufficiently packed. Ship by prepaid express, United Parcel Service, or insured Parcel Post to:

Heath Company
Service Department
Benton Harbor, Michigan 49022

HEATH

ZENITH

MP MASTER

MA23158

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*THE WORLD'S FINEST ELECTRONIC EQUIPMENT IN KIT FORM*

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